EE42/100 Spring 2006 Problem Set 3

Issued: Feb 2, 2006 Due: Feb. 10, 2006

Please remember that homeworks are due at 12:00 noon Friday January 26.
Please put your homework in the appropriate box (EE42 or EE100) in 240 Cory Hall. Print your name(s) in upper right corner of your paper and indicate whether you're enrolled in EE42 or EE100.

1. *(Reading Assignment)* Chapter 3, and Secs. 4.1-4.3: Hambley 3rd edition.

2. *(Capacitive level sensor)* Hambley Problem 3.32. Instead of the values given, suppose first that the liquid in the sensor is water and find the capacitance as a function of the height x of the liquid. Now suppose when the water level is at 99 cm a 1-cm thick layer of oil (having relative permittivity = 10) is floated on top of the water. How much would that change the capacitance of the plates?

3. *(Equivalent circuits)* Find the Thevenin and Norton equivalent circuits of the circuit shown in Fig. 1.

4. *(Thevenin equivalent of circuit with voltage and current sources)* Find the Thevenin equivalent of the circuit of Fig. 2. Find the Thevenin resistance (a) by using the short-circuit current, and (b) by the alternate method where you turn off all the sources.

5. *(Thevenin equivalent of a real battery)* We wish to find the approximate equivalent of a certain battery without measuring the short-circuit current, which might damage the battery. Instead, we connect a 40 Ω resistor across it and find the measured current to be -0.1125 A. The open-circuit voltage is found to be exactly 6 volts. Find V_T and R_T.

6. *(Superposition method)* Find the voltage V_R across resistor R in the circuit of Fig. 6 using the principle of superposition. Do you think using superposition simplified solving this particular problem?

7. *(Combining elements)* Find a single capacitor that is equivalent to the capacitors connected as in Fig. 7a. Find a single inductor that is equivalent to the three inductors connected as shown in Fig. 7b.

8. *(Current charging a capacitor)* Suppose a constant current I_0 = 10 mA flows through a 10 μF capacitor (Fig. 8). Find the voltage across the capacitor as a function of time assuming that the capacitor is uncharged at time t = 0.

9. *(Charging and discharging capacitor)* Hambley Problem P3.6. (Note: it should read that the capacitor is *charged* to 1000 V.)

10. *(Current, power and energy for capacitor)* Hambley Problem 3.8.

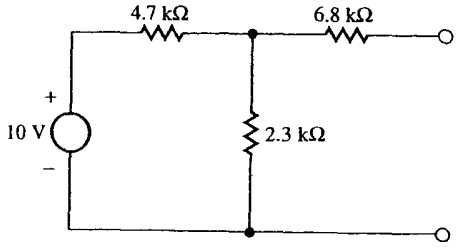


Fig. 1

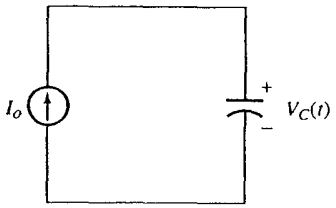


Fig. 8

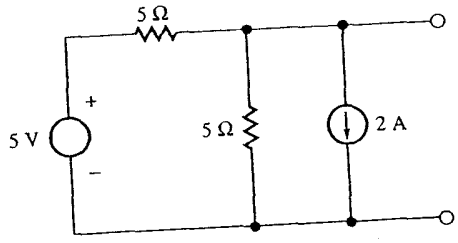
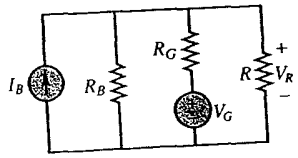
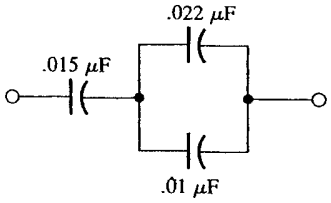


Fig. 2

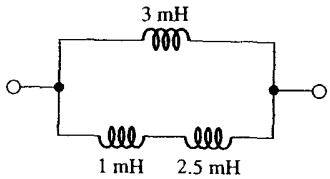


$I_B = 12$ A; $V_G = 12$ V; $R_B = 1\ \Omega$; $R_G = 0.3\ \Omega$; $R = 0.23\ \Omega$.

Fig. 6



(a)



(b)

Fig. 7